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AN EXPERIENCE OF DESIGNING AND CONSTRUCTION OF RESIDENTIAL BUILDING IN THE STRAITENED URBAN ENVIRONMENT

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Stručni članak

Sažetak: *U članku je predstavljeno iskustvo geološki i reljefno zahtjevnog gradilišta. Zbog nepovoljnih visinskih razlika izvodio se polu-podzemni parking na 3 nivoa. Osiguranje građevinske jame izvedeno je uz pomoć dva reda bušenih pilota povezanih naglavnom konstrukcijom i žmurja. Potporna konstrukcija integrirana je u opću konstrukciju stambene zgrade. Provedeni su odgovarajući proračuni osnovnih parametara i opće stabilnosti građevine. Kontrolna ispitivanja bušenih pilota potporne konstrukcije i pilota temeljne konstrukcije potvrdili su ispravnost i efektivnost odabranog projektnog rješenja.*

Ključne riječi: *aktivni i pasivni tlak, bušeni piloti, građevinska jama, žmurje*

Professional paper

Abstract: *In the article the experience of mastering a difficult geological and relief related site area is presented. The drop markers led to the necessity of constructing a semi-underground three-level parking. The protection of foundation pit from existent building and transport communications is accepted as a sheet pile wall from double-row borings piles, incorporated by grillage. Sheet pile wall is integrated into the structural scheme of the building. The appropriate calculations of the basic parameters and the overall stability of building are executed. Routine tests of borings piles wall and prismatic piles of main pile field have confirmed the validity and effectiveness of the design decision.*

Keywords: *active and passive pressure, bored pile, pit of variable depth, sheet pile wall of the fence*

1. INTRODUCTION

Reconstruction and new construction in a historical continuum of urban development poses the problem of operational implementation of technically and technologically advanced engineering solutions for designers and builders [1]. This is due to the following objective factors: the tightness of construction sites, surrounded by existing buildings; the complexity of the geological and hydrogeological conditions; significant drop markers of relief; the need for transferal of urban communications and other.

All of the above takes place in the central part of Odessa (Ukraine) in the area adjacent to the Zhukovsky street (Fig. 1). Natural height difference between the Polish street and Devolanovskiy descent became a major factor in the development of this project site. Study of possible options for the design decisions led to the device in the side beams semi-underground three-level parking. In this connection there was need for excavation a pit of variable depth - from 1m by the Devolanovskiy descent to 10 meters along the Zhukovsky and Polish street.

2. FEATURES OF THE PROPOSED DESIGN METHOD

In the design of deep pits, arranged in the immediate proximity and below the level of the foundation surrounding structures, special measures are necessary to protect them from possible settlements and deformations.

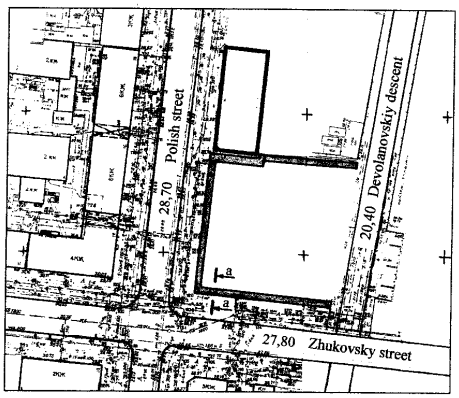

Figure 1. Situational plan of the site with the contours of the pile raft foundation of pit building under construction

One way to protect the pit, the surrounding buildings and traffic intersections is a device sheet pile wall.

Significant and variable on the plan the depth of the pit caused by the terrain of the construction site, has dictated the choice of its enclosure in the form of sheet pile wall unanchoring double row bored piles, whose union on top of monolithic reinforced concrete raft foundation has given the whole structure additional spatial stiffness [2].

A design scheme of this retaining wall is a cantilevered beam having a footing at the base and located in static equilibrium from active and passive pressures of soil. The problem was to determine the depth of setting the size of the wall. Calculation of the adopted wall structure was performed by "elastic line" of Blum-Lomeyer [3].

Due to the complexity of diagrams the thrust and resistance of soil due to its heterogeneity, known Graphic analytical methods used. In the first step of calculating diagrams of the active and passive soil pressures on the wall, taking into account the surface strip load from the existing strip foundation were constructed. The resulting diagrams are divided into individual sections and replaced by concentrated forces. Next the power and rope polygons constructed to these forces of. The torque values are defined by the product of the pole distance to scale forces in the corresponding ordinates of a closed rope polygon to scale lengths. Lower-bound of the current diagram of the passive soil pressure and the calculated depth of wall embedment obtained by the point of intersection the rope-gon with closing the vertical.

The resulting bending torque by method of the elastic line, in our opinion, is too high a value of the possible redistribution of soil pressure caused by the flexible wall. Wherein the pressure decreases in the span and increases in the anchor footing. Therefore, taking into account the rigidity of the wall and the soil characteristics, the maximum torque in the wall adjusted by the accordingly coefficients founded from the graphs given in [2, p. 464].

Checking of the total steadiness of the adopted construction of the partition wall is made by the technical theory of limiting stressed state of soil ground of P.Yakovlev and by the method of Maslov-Bearer [4, 5].

The sequence of work of the zero cycle led to the use of piles of sheet piling as the foundation for the outer walls constructively, thereby significant saving of concrete, reinforcement, time and manpower achieved. Principal scheme of the pile fence and its integration into the building structure are shown in Fig. 2.

In the design came from the fact that two bored piles Ø350 mm per 1 rm fencing arranged in a transverse direction, should create a couple of forces to perceive the calculated bending torque. Based on this, the force in the reinforcement of single stretched pile must balance the strength in compression of the other pile.

For the perception of the calculated bending torques, taking into account the variability of engineering-geological conditions, variable height of the walls of the pit and loads from the existing building and other structures, the distance between the two rows of piles (magnitude of shoulders) taken: from the Polish street of the - 1.95 m; from the Zhukovsky Street - 1.95 m and 3.2 m; from the existing residential home - 3.5 m.

At the level of existing blind area piles combined by thick of 600 mm monolithic concrete grillage, which is the reinforcement in the transverse direction is calculated from the condition of the hard crushing and loading of the outer wall.

The length of the bored piles fence confirmed with above calculations and assumed equal to the depth of the pit and the necessary length of their incorporation into the ground. It ranges from 16...18 m, and mark their heels are almost corresponding to marks heel pressed prismatic piles of main field.

Checking the strength of materials piles made of assuming their elastic behavior, based on the magnitude of a possible move of foundation grills in the direction of the pit. The geometrical characteristics given to concrete per meter cross-section of the pile fence - moments of inertia and resistance - were determined for this. It was found that edge stresses in sections of piles are within the boundaries of the calculated resistance of materials, and the horizontal displacements of grillages did not exceed the statutory limits [6].

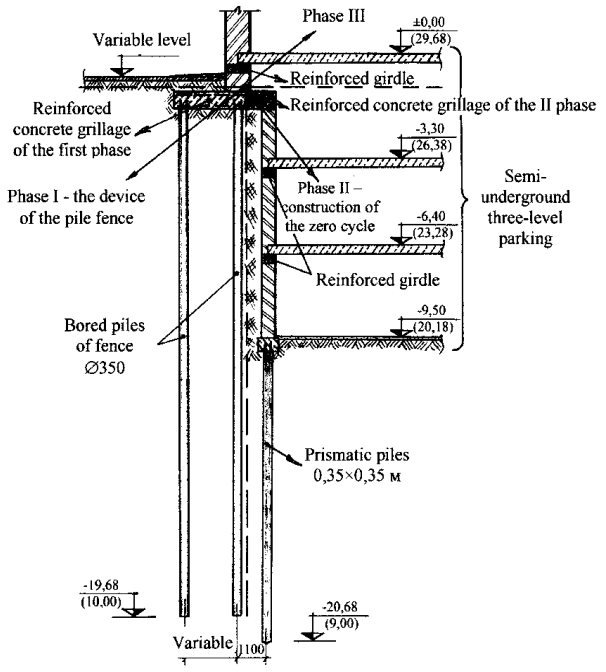

Figure 2. Principal scheme of the device of fencing pit in view of its use in the structural scheme of building under construction (a-a)

The calculation does not take into account the friction forces on the lateral surface of the pile and soil mass work concluded between the piles on shift that has gone into the reserve of strength and stability of fencing pit. The control tests showed that the total carrying capacity of bored fence piles and crushing prismatic piles of the main pile field on the vertical load exceeds the permissible rated load from the outer wall, which confirmed the validity of the accepted decision [7].

To obtain objective quantitative feedback parameters confirming the accuracy of the decisions, as well as for their potential operational adjustments, the construction process, the behavior and the state of the surrounding

buildings and structures geotechnical monitoring was carried out.

Dwelling-house, built using solutions described in this article, normally operated for seven years (Fig. 3).

3. CONCLUSION

Intercalation of enclosing bored piles as an additional power element of resistance to carrier constructive scheme has allowed increasing the efficiency and to optimize the combination of the ratio of operational reliability and cost effectiveness in the construction of multi-storey apartment building with a semi-underground three-level parking.

a)

b)

c)

Figure 3. Dwelling-house with semi-underground three-level parking

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